



## **CERAMIC TILE INSTITUTE OF AMERICA, INC.**

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### **CTIOA FIELD REPORT 85-1-1 (R-86)**

#### **SUBJECT: Epoxy Injection for Re-Bonding Loose Tile**

#### **A. INTRODUCTION**

1. The tile industry has had its share of ceramic tile installations loosing their bond to various surfaces. Ceramic tile may become loose from their bond because of the following reasons or combination thereof.
  - a. Improper substrate preparation or specification, i.e.: concrete slab may have a steel trowel or burnished finish. The standard of the tile trade requires a steel trowel and a light broom finish. The light broom finish texture is necessary to provide small pockets for the bonding mortar to key into the concrete, thus providing a higher shear bond strength.
  - b. Curing compounds are widely used by contractors in spite of the warnings and literature forbidding their use to sure concrete. The manufacturers indicate the compound will oxidize in 30 - 45 days but CTI knows this is true only under ideal conditions. When the concrete covered with curing compounds is not exposed to the ultra violet ray of the sun these curing compounds have been present on slabs nearly two years old. Some compounds may last longer than two years.
  - c. Lack of or improperly installed expansion joints, cause

many tile installations to fail by tile losing their bond. Many tile installations require expansion joints throughout the field. However, all tile installations shall have expansion joints at the perimeter and especially where the tile surface abut rigid wall, columns, or dissimilar planes.

- d. Deflection of substrate contributes its share of problems to tile failures. The tile industry has established 1/360 of the span as the maximum amount permissible to assure that the tile will remain bonded.
- e. Premature traffic over a freshly installed floor will cause a loss in bond of the tile. The ANSI specifications require to keep traffic off for at least 72 hours but CTI prefers 7 days because of uncertainties, in curing time, with the materials and climatic conditions.
- f. Excessive abuse or misuse of the tile and bonding materials can cause loss of bond, In some cases a high absorptive tile may not have been pre-moistened or the concrete has sucked the moisture out of the bonding mortar too rapidly for proper hydration of the cement in the bonding mortar. Either condition may result in a failure.
- g. Contaminates on the substrate while applying the bonding mortar may cause problems especially to an improperly or untrained mechanic. A trained mechanics will always clean the surface of contaminates before tiling. If contaminates are present, the bonding mortar will usually roll up at the time of application.
- h. Poor workmanship is also a potential cause but is extremely rare in well qualified craftsmen. Poor workmanship is more prevalent with the unlicensed or unschooled mechanic. Many geographical areas in the USA has set up apprenticeship schools to properly train and educate the mechanics for our trade.
- i. Bonding tile to uncured concrete usually will cause a failure. The ceramic tile institute recommends that the concrete slab shall cure for 28 days before tile are directly adhered to the surface. This time is necessary for a proper cure and will allow for the slab to shrink to

approximately its maximum amount.

2. Of all the ceramic tile installations, an extremely high percentage never have any problems and provide the most cost effective, beautiful, durable and functional surface of any other surface material. Therefore, epoxy injection should not be a crutch or the "ace in a whole" or substitute for quality installing of quality materials used in compliance to proper specifications.

## **B. DISCUSSION**

1. What is Epoxy Injection? Epoxy injection as used in the tile trade and further discussed within is a means to re-bond a separated tile installation. Cracks within the concrete slabs or other substrates may also be repaired by filing and adhering the separated parts with an epoxy resin.
  - a. The epoxy resin adhesive is a two component liquid epoxy containing 100% solids and specially formulated to be injected, by an epoxy injection machine, through a nozzle. The epoxy components are mixed in the nozzle for better control and immediate injection.
  - b. The adhesive is a low viscosity liquid, containing no solvents and cures at room temperature. At a curing time of 24 hours at about 77 degrees F. the bond strength is so great that the concrete or tile will usually break first before the bond fails. The shear strengths are in excess of 4000 PSI and compression strengths exceeding 15,000 PSI.
2. When should epoxy resin adhesive be used?
  - a. Whenever the conditions are favorable to restore the monolithic integrity of a damaged ceramic tile installation. A determination of the extent of damage is necessary, i.e.: the separation within the system should not be excessively wide (preferably less than 1/8"). The surfaces to be rebonded need to be clean or cleanable and solid (not powdery). An evaluation as to the cost effectiveness of restoring vs. replacement.
  - b. Whenever the esthetics of the job dictates that replacement is not feasible. For example, a mural may

have a crack caused by an earthquake in its backing material. The crack could be rebonded and then tesserae carefully remounted over the crack and blended into the facial image.

3. How is it used? Epoxy resin adhesive is installed in a variety of methods. Some mix the two components and pour the liquid. Other installers use various materials to bridge over the surface of the crack and then pump the liquid through a tube attached to the crack. Still others drill holes at random and pump liquid into these holes until the liquid flows out at some unknown destination.

The best method that CTI has observed is to strategically locate the areas that have separated, identify these areas and mark the boundaries, precisely drill a minimum of small holes in the grout joints between the tile, inject the two component resin with the proper equipment, monitor the flow of the liquid in the void by continuous sampling, clean up all excessive resin before it has a chance to harden (Acetone will clean off liquid), and properly refinish the surface which would include the re grouting of the holes to blend with the existing grout color and texture.

For the extended workability of the epoxy resin adhesive the two components are to be mixed in the nozzle. The components may also be slightly heated to allow additional penetration. The components may be purchased in colors to assist the installer in evaluating the proper mix at the nozzle, i.e.: Component A is available with a yellow dye, B with blue dye therefore properly mixed will result in a green mixture.

4. What are the costs?
  - a. The epoxy resin adhesive is a medium priced epoxy. Related to the conventional materials used in the tile trade, epoxies are generally expensive.
  - b. The storage of the raw materials are expensive because of the short shelf life (approximately 1 year).
  - c. The installation by a competent epoxy injection contractor can vary between a tenth to one-half the cost

of reinstalling the ceramic tile system. Cost estimates are recommended to determine the cost effectiveness. The cost of removal of the damage system plus the cost of scarification of the substrate and/or repair to substrate plus the inconvenience cost to all parties due to the time delays for repairs plus the relocation cost of equipment or furniture if the area was inhabited and finally the cost of replacement of the tile. Any failure is a very costly event to all parties including the tile industry. The actual "out-of-pocket" cost for epoxy injection is extremely difficult to determine until a complete analysis of the failure is obtained.

5. What are the dangers?

- a. In addition to the potential physical danger to individuals there is the possibility that the voids that are to be rebonded are heavy with contaminants and not cost effective to get out.
- b. The possibility that the surfaces are not in a bondable condition. The epoxy manufacturers insist that the surfaces to receive adhesive shall be clean, free of dirt, loose particles, oil, grease, asphalt, tar, paint, wax, rust, waterproofing, curing and parting compounds, membrane materials and other contaminants which might prevent satisfactory bond and/or epoxy cure.
- c. Dermatitis may be caused by exposure to the epoxy resins. The manufactures print important warnings, "should skin contact with epoxy occur, immediately wash with soap and water, then rinse thoroughly with water for several minutes. NEVER try to remove epoxy from skin by using any kind of solvent. Good protection can be provided by the use of clean rubber gloves, disposable gloves, or skin creams, Special care should be taken to protect the face and eyes, flush for 10 minutes with water and secure immediate medical attention. Good ventilation is required when applying epoxy in indoor areas." The long term effects from continuous contact may not be apparent.
- d. The damage caused by spills to the tile and surrounding materials is difficult to determine due to the workmanship of the installer and any accidents that may

occur. The cleaning up shall be immediate with proper materials to minimize the potential material damage.

6. Are there any guarantees or warranties? Very limited at best!

a. The manufacturer of the material usually will print their warranties or as in one case their non-warranty, "this product is sold without warranty and no implied warranty is to be raised from circumstances accompanying sale or use thereof. Results obtained by the use of our products depends on workmanship and conditions under which the materials are used, and engineering and inspection, over which we have no control.

Therefore, the only guarantee that is given by us is to replace such goods that are defective in manufacture, or give credit at our option. Under no circumstances are we responsible for any damages beyond the price of the material, and no charge for labor, expense, or consequential damages will be allowed. If materials prove to be defective, the measure of damage is the price of the defective material. Our salesmen or representatives have no authority to extend any guarantee beyond that outlined above."

b. The epoxy injection contractor may warranty their work depending upon the factors dealing with the rebonding of the failure. We suggest that all warranties be written and all intents of the specifications be thoroughly understood and mutually agreed upon.

### **C. CONCLUSION**

1. The best of all worlds when installing ceramic tile is to use quality materials, write proper specifications, draw detailed methods on the plans, use certified quality tile contractors, allow ample time for the mechanics to install the tile and provide adequate supervision.
2. If a bond loss occurs and conditions warrant then epoxy injection may be the next best solution in lieu of removal and replacement.
3. Contact the Ceramic Tile Institute of America for the company names of the epoxy injection contractors who are recognized

by the trade for their quality performance.